RESTRICTED CIRCULATION

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AGRICULTURAL MEMORANDUM 519

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Weather and Barley Yield (2)

Number of Grains per Ear

The number of grains per ear, G, is not given directly in the European Brewery Convention barley trials, but was calculated from

$$G = \frac{100Y}{CNP}$$

Y = dry matter grain yield in kg/ha.

C = 1,000 kernel dry weight (gm).

N = number of ears per plant.

P = plant density (number per square metre)

46 trials had sufficient crop and weather data, though weather data also had to be found from other sources for about half the trials.

Rejected Data

Frost damaged one Spanish trial 5 days before ear emergence and the data was not used. Two trials had very high grain numbers (29.0 and 31.4 per ear compared with the overall mean of 15.4). This was associated with very low ear numbers (1.29 and 1.22 ears per plant) and suggests a fault in the data. These three trials were not used which gave 43 sets of values for the regressions.

Factors Affecting Grain Number

Slatyer (1970) has discussed two sensitive periods:

1) The formation of stamen initials. The potential number of spikelets per ear is governed by the rate of floral primordium initiation relative to that of spikelet development. Initiation of new floral primordia ceases when stamen initials form on the first formed spikelets. Any factor which speeds up spikelet development relative to primordia production will reduce the number of spikelets per ear. Long photoperiods and moisture stress prior to the formation of stamen initials are known to reduce the final spikelet number.

2) Fertilisation and seed set. If moisture stress occurs at this time then the potential spikelet number is not realised as grain.

Other factors which have been shown to affect grain number are plant density (Kirby, 1969) and the availability of nitrogen during early ear growth. Controlled environment experiments on wheat by Thorne et al (1968) have shown the importance of temperature prior to the formation of spikelets.

Examination of EBC trials

Soil Moisture

Soil moisture deficits were estimated every 10 days during the growing season at each trial site. C V Smith's 2-layer model for barley was used ie transpiration at the potential rate for soil moisture deficits below 3 inches, but at 0.45 the potential rate when the deficit exceeds 3 inches.

Some trials developed with the soil near field capacity for much of the time, while others developed deficits in excess of 3 inches by ear emergence. No definite relation between deficit and grain number was found.

Photoperiod

The photoperiod which the seedling experiences upon emergence is known to be important for the subsequent response to day length. For each trial the day-length at the approximate time of seedling emergence was found. This varied between 9½-10 hrs in Spain and Portugal to more than 18 hrs in Finland. The linear correlation between grain number per ear and photoperiod was - 0.43. Although this factor dealt with Spain and Finland quite well, there was a lot of variation in the grain number for the NW Europe trials which was not explained.

Plant Density

Grain number and plant density had a correlation of - 0.59. However, since the correlation between photoperiod and plant density was also significant (+ 0.56) this analysis cannot distinguish between the effects of photoperiod and plant density. Kirby (1969) showed that the effect of photoperiod was small compared with plant density, and it is assumed here that density is the more important factor except possibly for Finland and Spain.

Temperature

For each trial the mean air temperature between brairding and the estimated time of stamen initiation was found. This temperature had a correlation with grain number of - 0.25. However, if the mean air temperature for the period 10-20 days prior to stamen initiation were used instead, then the correlation increased to - 0.55. This latter temperature factor taken together with plant density has a multiple correlation with grain number per ear of 0.81.

Conclusions

These trials indicate 2 main factors which govern grain number.

1) Plant density. This reflects plant competition for some factor important to the developing ear eg light or nitrogen.

2) Temperature. High air temperatures several weeks before ear emergence are significantly correlated with low grain numbers. If the critical period really is the pre-stamen formation phase then this result supports the findings of Thorne et al (1968). In England the critical period is approximately the first two weeks in May.

3) Photoperiod appears to be important for Finland (60°N) and Spain (37°N).

Any comments or criticisms should be sent direct to the author.

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